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Digital innovation in SMEs: a systematic review, synthesis and research agenda

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ABSTRACT

This paper presents a systematic literature review on digital innovation in Small and Medium-sized Enterprises (SMEs). It aims to synthesize previous research and identify knowledge gaps and future research opportunities. A systematic review of the literature was carried out by analyzing 382 articles published between 1979 and 2019. From synthesizing the extant literature, we developed a theoretical framework advocating that digital innovation in SMEs is driven by a configuration of antecedents, goes through different stages of innovation process, and leads to organizational and business process performance outcomes. Using an in-depth content analysis, we discuss the examined digital technologies, theories underpinning digital innovation in SMEs research, contextual orientations, and the content of research in this field. This review identifies significant knowledge gaps in relation to theory, context, method and content.

KEYWORDS

Digital; innovation; technology; ICT; IT; SME

Introduction


Over the last four decades, an extensive body of work has surfaced on digital innovation in SMEs (e.g. AlBar & Hoque, 2019; Ramdani et al., 2009; Stair, 1979; Thong, 1999). Digital innovation is defined as ‘product, process, or business model that is perceived as new, requires some significant changes on the part of adopters, and is embodied in or enabled by IT’ (Fichman et al., 2014, p. 330). It is an overarching term that is used to represent the organizational exploitation of digital technologies including Information and Communication Technologies (ICT), Information Systems (IS), and Information Technology (IT) among others. Although scholars have carried out several reviews on the general literature of digital innovation (Fichman, 1992, 2004; Jeyaraj et al., 2006; Kohli & Melville, 2019), there is often ambiguity on what we know about digital innovation in SMEs.

SMEs are commonly defined as firms that have less than 250 employees (European Commission, 2016; OECD, 2005). They represent the majority of business enterprises, and contribute substantially to employment and turnover in developed nations (European Commission, 2016). Compared to SMEs in developed countries, SMEs in developing countries have a greater impact on their countries’

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economies (Cataldo et al., 2020). Small businesses are the engine and the driving force of economic development (Hanclova et al., 2015; Ntwoku et al., 2017). They are argued to be more efficient in creating quality jobs, are more innovative and grow faster than large companies (Gibson & van der Vaart, 2008). Thus, governments in low- and middle-income countries use SMEs as instruments for national development (Ilavarasan, 2017). However, studies have ignored SMEs and their role in development (Andoh-Baidoo, 2016).

Digital technologies provide SMEs with new opportunities such as better access to skills and talent, greater access to markets, more extensive access to financing, better communication and collaboration, greater access to technologies and applications, more extensive product development, and reduction in red tape (OECD, 2017). As a result, digital technologies enable SMEs to compete against their larger counterparts by leveling the playing field (IDC, 2016). Moreover, the recent World Development Report indicates that technology is making firms global and enabling them to grow faster (World Bank, 2019). Digital technologies have been hailed as the answer for developing countries by enabling their SMEs to leapfrog stages of development (Mbuyisa & Leonard, 2017). These technologies can help SMEs in developing countries to improve their productivity and competitiveness (Ahmad et al., 2015; Albar & Hoque, 2019; Hanclova et al., 2015). Despite the potential benefits of digital technologies, the reality is that SMEs are reluctant to be involved in digital innovation, or fail to derive benefits from new technologies.

Researchers examining digital innovation in SMEs focused on the determinants of adoption, the uptake of digital technologies, and the outcomes associated with adoption. A large body of the literature looked at these determinants including individual, technological, organizational, and environmental characteristics (e.g. AL-Shboul, 2019; Awa & Ojiabo, 2016; Ramdani et al., 2013). Other studies looked at the uptake of digital technologies by SMEs. Empirical evidence suggest that SMEs are lagging behind large companies (Ntwoku et al., 2017), SMEs operating in developing countries are lagging behind those operating in developed countries (Cataldo et al., 2020), and rural SMEs are lagging behind urban SMEs (AlBar & Hoque, 2019). The outcomes associated with digital innovation range from cost reduction (e.g. Tan et al., 2010), profitability (e.g. Bala & Feng, 2019), customer satisfaction (e.g. Scuotto et al., 2017), competitiveness (e.g. Adeniran & Johnston, 2016), and internationalization (e.g. Pergelova et al., 2019), to product, process (Peón & Martínez-Filgueira, 2020), and business model innovation (Bouwman et al., 2018).

Although much of the literature exists on digital innovation in SMEs, it is yet to be reviewed and synthesized. To stimulate scholarship and provide a better sense of direction, we offer the first systematic review of this literature. We specifically endeavor to answer the following questions:

- • What is known on digital innovation in SMEs research?
- • What are the research opportunities to enhance current knowledge on digital innovation in SMEs?

This review aims to make sense of what we know on digital innovation in SMEs and to propose a research agenda built on renewed theoretical direction to address knowledge gaps. To these ends, 382 articles published between 1979 and 2019 in 105 journals will be analyzed. Our review makes meaningful contributions to theory and research. First, we develop a theoretical framework of digital innovation in SMEs to examine existing evidence. Second, we synthesize existing evidence using our theoretical framework to establish what is known on digital innovation in SMEs research. Third, we set out a roadmap for future research agenda proposing multiple directions for theory, context, and content of digital innovation in SMEs.

Our review is organized as follows. The next section will outline our guiding theoretical framework and its underpinning conceptualizations. Then, the review method process and steps for analyzing the identified articles will be highlighted. After that, the results of this review will be discussed in relation to the theories used, the context, and the content under study. Finally, directions for future research opportunities will be suggested.

Theoretical framework

To assess and advance the content of what is known in this field, we have developed a theoretical framework of digital innovation in SMEs (Figure 1). This framework is based on three conceptualizations in the extant literature with constructs described in Table 1.

The first conceptualization is the ‘Revised depiction of the dominant paradigm of IT innovation’ (Jeyaraj et al., 2006). This conceptualisation advocates that individual, innovation (technological), organisational, and environmental antecedents influence the quantity and speed of digital innovation adoption and diffusion by organisations and individuals within organisations. This conceptualisation has been used for three reasons. First, this conceptualisation is based on a comprehensive review of the theories and empirical studies on organisational uptake of digital technologies. Second, it groups the antecedents into recognisable categories that have been used not only in the general digital innovation literature, but also used in small business context. Third, Jeyaraj et al. (2006) specified the dependent variables used in the digital innovation literature including

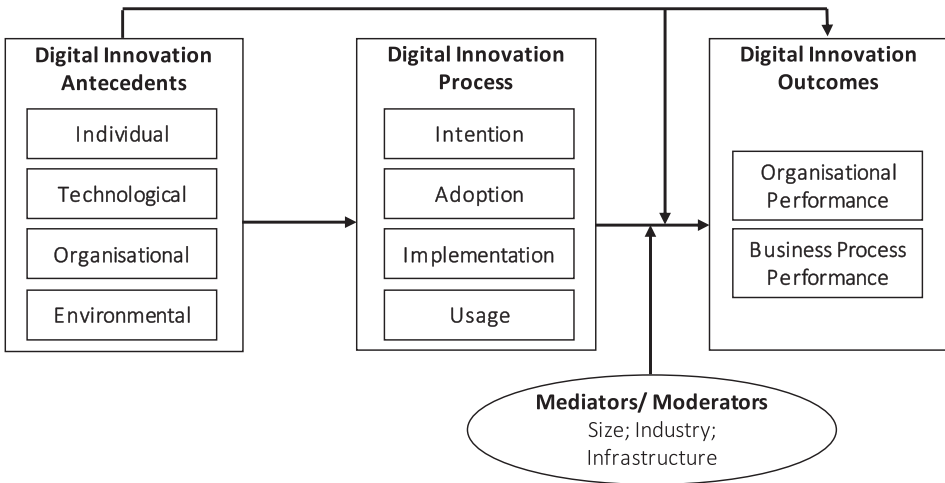


Figure 1. Digital innovation in SMEs framework.

Table 1. Theoretical framework constructs.

Construct	Description
Individual antecedents	<i>The characteristics that describe an individual, such as Age (Jeyaraj et al., 2006, p. 10)</i>
Technological antecedents	<i>The characteristics that describe the innovation, such as those described by TAM and Innovation Diffusion Theory (Jeyaraj et al., 2006, p. 10)</i>
Organizational antecedents	<i>The characteristics that describe the organization, such as Top Management Support (Jeyaraj et al., 2006, p. 10)</i>
Environmental antecedents	<i>The characteristics that describe the environment (Jeyaraj et al., 2006, p. 10), such as External Pressure</i>
Intention	<i>A person's or an organization's intention to use or adopt an innovation in the future (Jeyaraj et al., 2006, p. 5)</i>
Adoption	<i>Whether a person or an organization is an adopter or a non-adopter of an innovation (Jeyaraj et al., 2006, p. 5)</i>
Implementation	<i>The extent to which a person or an organization exploits an innovation. This is usually measured as a percentage of available features used, possible sites adopted, or possible applications (Jeyaraj et al., 2006, p. 5)</i>
Usage	<i>The amount of actual use of an innovation by an individual or organization (Jeyaraj et al., 2006, p. 5)</i>
Organizational performance	<i>Overall firm performance, including productivity, efficiency, profitability, market value, competitive advantage, etc (Melville, Kraemer, & Gurbaxani, 2004, p. 295)</i>
Business process performance	<i>Operational efficiency of specific business processes, measures of which include customer service, flexibility, information sharing, and inventory management (Melville et al., 2004, p. 295)</i>

intention, adoption, diffusion, and actual system use, which characterise the different stages of digital innovation maturity.

The second conceptualisation is the 'IT business value', which is 'the organisational performance impacts of IT' (Melville, Kraemer, & Gurbaxani, 2004). This conceptualisation categorises the business performance into organisational performance, and business process performance. While the former focuses on the overall performance of the firm, the later focuses on the operational aspects of business processes. This conceptualisation has been used to augment a missing construct in the first conceptualisation (i.e. digital innovation outcomes). Although organisational outcomes of digital innovation can be product, process and business model innovations, the organisational impacts of digital innovation in SMEs have examined the impact of digital innovations on the business process as well as the overall performance of SMEs.

The third conceptualisation is 'Going Beyond the Dominant Paradigm for Information Technology Innovation Research' (Fichman, 2004). The dominant paradigm of digital innovation research advocates that the more firms possess certain characteristics, the more likely they are to be involved in digital innovation. According to Fichman (2004), 'This paradigm is typified by the desire to explain innovation using economic-rationalistic models, whereby organizations that have a greater quantity of what might be called "the Right Stuff" (i.e., greater innovation-related needs and abilities) are expected to exhibit a greater quantity of innovation (i.e., greater frequency, earliness, or extent of adoption)' (p. 315). To go beyond this dominant paradigm, he suggests three aspects that link the first and second conceptualisations: digital innovation antecedents direct (and moderating) links with outcomes, the association between digital innovation process and outcomes, and the mediators and/or moderators of the digital innovation process-outcome relationship. This conceptualisation does not only bring together the constructs that are examined in the digital innovation literature, but also establishes the linkages between them. Also, it opens up avenues for future research by exploring these linkages.

To summarize, digital innovation in SMEs is driven by a configuration of four sets of antecedents (i.e. individual, technological, organizational, and environmental), goes through a four stages process (i.e. intention, adoption, implementation, and usage), and leads to organizational and business process performance outcomes. Some of the digital innovation antecedents have a direct impact on digital innovation outcomes. Also, these antecedents and other variables (such as size, industry and infrastructure) could mediate and/or moderate the digital innovation process-outcomes relationship. Our framework builds on previous conceptualizations in the digital innovation literature (Fichman, 2004; Jeyaraj et al., 2006; Melville et al., 2004). It brings together the key variables and relationships of digital innovation in SMEs. Having this level of abstraction can help map out what we know in this field and any knowledge gaps that could be addressed.

Review method

This review followed the systematic literature review approach advocated by Denyer and Tranfield (2009). Compared with conventional 'narrative' reviews, systematic literature review is a structured process for identifying, synthesizing, and evaluating extant research (vom Brocke et al., 2015). Figure 2 provides a summary of the process used to prepare this review. We began the review process by establishing the research objectives and conceptual boundaries. Our review aims to describe what is known on digital innovation in SMEs research and to identify research opportunities to enhance existing knowledge. As noted in the theoretical framework section, this review followed the definitions and conceptualizations provided by digital innovation scholars.

A sequential process of searching, analyzing and synthesizing, and writing has been applied for our literature search (vom Brocke et al., 2015). The criteria for selecting the articles to be included in our review are detailed in Table 2. We use a keyword search that is based on a range of possible terms of 'digital innovation' and 'SME,' and a variety of search databases (Web of Science, Scopus, and EBSCO Discovery Service) to achieve a broad coverage. A full list of Key Boolean search terms

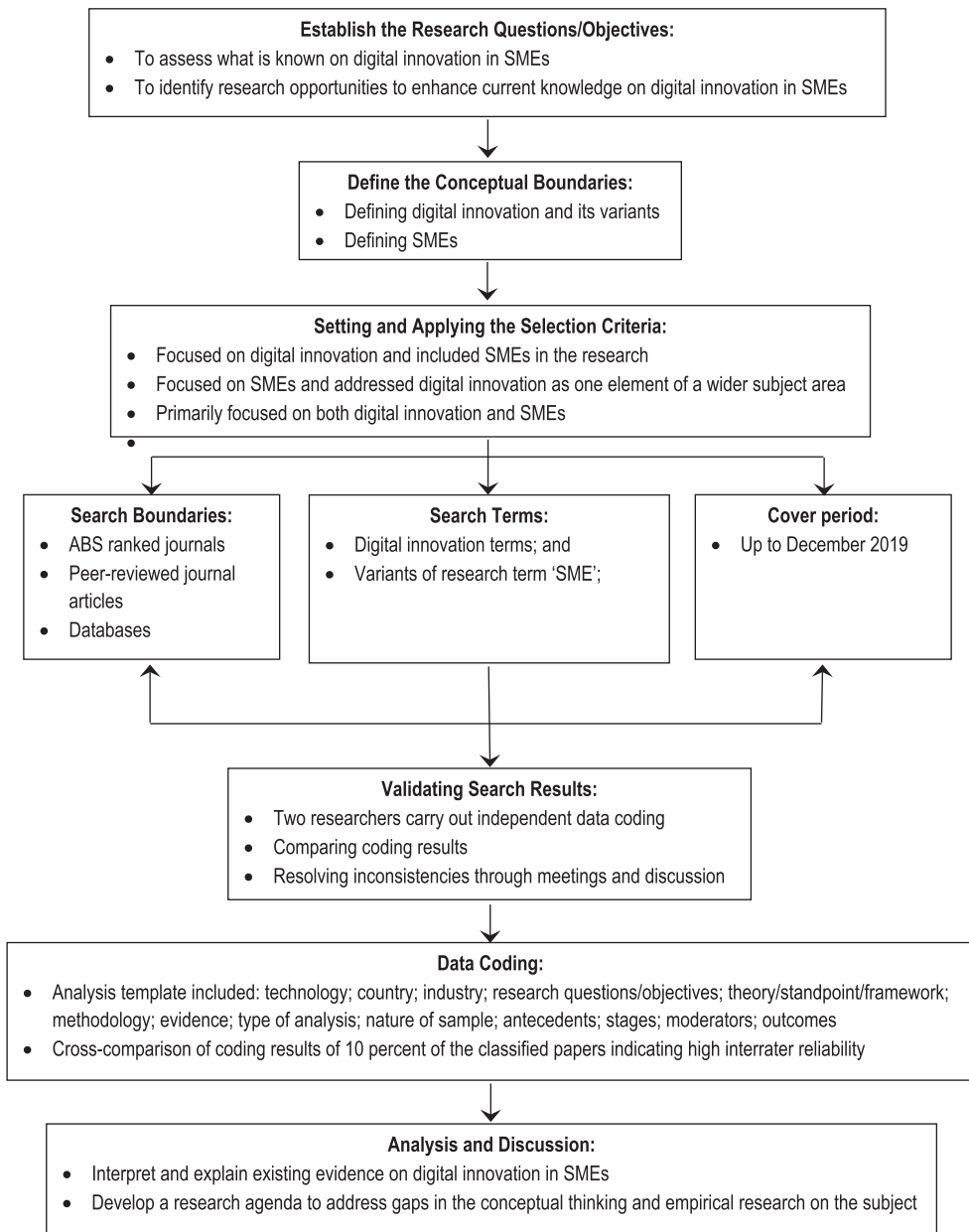


Figure 2. Summary of review process.

is highlighted in the Appendix A1. Our search resulted 382 articles, which were deemed relevant after applying the inclusion and exclusion criteria. Appendix A2 lists the journals, number of articles per journal, and the journal ranking. Based on the initial search results, the first and second author examined the identified papers and whether they are within the boundaries established for this field of research. Papers identified by both authors to be within the research boundaries are added to the review scope. In case one of the authors questioned the inclusion of an article, then the content of the article will be discussed by the first and second author until consensus was reached. The third author reviewed questioned papers, and a consensus was reached on all included and excluded articles.

Table 2. Selection criteria.

Criterion	Inclusion	Exclusion	Rationale
Relevance for review questions	Research with a core focus on both digital innovation and SMEs Research Focused on digital innovation and included SMEs in the research Research focused on SMEs and addressed digital innovation as one element of a wider subject	Papers not focusing on digital innovation	To provide data that will be used to answer the review questions
Date of publication	Up to December 2019	None	No restrictions were applied to enable the coverage of all studies in the area
Language	English	All other languages	Research team's resource constraints
Type of publication	Peer-reviewed journal articles	Books; book chapters; conference papers and proceedings; theses, working papers; reports; press articles	Other types of publications and grey literature were excluded due to the limited peer review process
Journal ranking	UK Association of Business Schools (ABS) <i>Academic Journal Quality Guide</i> , Version 5 (ABS, 2015)	All other journals	This guide was used because assessments of journal quality have been recognized as means of ensuring robustness of systematic literature reviews (Wang & Chugh, 2013)
Disciplines	All subject areas	None	Most of the research for this review is either published in Information and Management discipline or Entrepreneurship and Small Business Management discipline
Databases	Web of Science, Scopus, and EBSCO Discovery Service. Articles that are not available will be searched manually using ScienceDirect and GoogleScholar	None	Searching more than one database will achieve a broader coverage
Type of research	Theoretical, Empirical, Literature reviews	None	All types of research were identified as relevant in answering the review questions
Methodology	All	None	All methodologies were considered in this review
Context	All	None	Research originating in all countries was considered in this review
Sample	SMEs that have a digital innovation	Innovations that are not digital	This review excludes other types of innovation such as intellectual property as these are beyond the scope of this review

A deductive approach was used to systematically analyze the articles in our sample. This is because the review was guided by the theoretical framework of digital innovation in SMEs. We extracted pre-determined research themes and sub-themes from the research context then synthesized existing evidence (Bandara et al., 2015). Guided by our theoretical framework, the first author and an external researcher coded the 382 papers identified in the literature search. An analysis template was used to record details on examined variables and relationships. Coding results were consolidated and any inconsistencies were resolved through meetings and discussion. Using Cohen's kappa, 10% of the papers were classified using our framework. For all three categories of digital innovation antecedents, process and outcomes, the two coders achieved an agreement above 82%. This level of Cohen's kappa indicates a high interrater reliability suggesting a substantial agreement between the raters (Landis & Koch, 1977). Data were synthesized not only to interpret and explain existing evidence, but also to develop a research agenda that addresses gaps in the conceptual thinking and empirical research on digital innovation in SMEs.

Results

In this section, we present the results of our analysis on the examined digital technologies, theories underpinning digital innovation in SMEs research, contextual orientations, and the content of research in this field. The content will present evidence on the variables and relationships in our theoretical framework.

Digital technologies

Several IT artifacts have been examined in this literature. As highlighted in [Table 3](#), researchers focused on examining ICT (28%), e-commerce (21%), enterprise systems (18%), and other technologies (15%). The Internet, web-based technologies, cloud computing, and social media were examined by a limited number of studies. New digital technologies such as Industry 4.0, Internet of Things (IoT), and business intelligence have recently attracted attention. On the one hand, digital technologies have been examined using aggregate terms such as ICT (e.g. Peón & Martínez-Filgueira, 2020), IT (e.g. Chege et al., 2020), digital technologies (Bouwman et al., 2018); Industry 4.0 (Annosi et al., 2019), and enterprise systems (e.g. Awa, 2019). It is understandable when researchers study a group of digital technologies that share the same features (e.g. enterprise systems). However, it is less obvious why researchers study groups of technologies without differentiating between them. Morgan-Thomas (2016) argues that research in this area assumes that digital technologies ‘have generic, predictable, and universal properties’ (p. 1123). Clearly, these are assumptions and the reality of digital technologies must be questioned due to having different features and functionalities. On the other hand, specific technologies such as ERP (e.g. Van Beijsterveld & Van Groenendaal, 2016), broadband (Bowen & Morris, 2019), and website (Daryanto et al., 2013) have also been examined in the literature.

Over the past 40 years, researchers have focused on studying digital technologies of the time (as shown in [Figure 3](#)) [1] by examining computerization and computer-based IS (CBIS) in the 1980s, to IT, IS and EDI (Electronic Data Interchange) in the 1990s, to ICT, Internet, website, e-commerce, e-business and enterprise systems in the 2000s, to cloud computing and knowledge management systems (2010-2015), to social media, Industry 4.0, digital technologies and digital platforms (2015-2019). It has to be noted that these phases are illustrative and some of the digital technologies such as ICT have been studied up to 2019.¹

Theories and models

In line with the general literature on digital innovation, early studies used Rogers’ (1983) diffusion of innovation theory (DOI), theory of planned behavior (Ajzen, 1985) and technology acceptance model

Table 3. Digital technologies examined in the literature.

Digital technologies	Terminologies	Percentage	Illustrative references
ICT	ICT; IT; IS; Digital technologies	28%	Peón and Martínez-Filgueira (2020); Chan et al. (2019); Caldeira and Ward (2003)
E-commerce	E-commerce; E-business; EDI; E-trade; E-marketplace	21%	Holland and Gutiérrez-Leefmans (2018); Fariselli, Oughton, Picory, & Sugden (1999)
Enterprise systems	EDI; ERP; CRM; SCM; Knowledge Management	18%	Biswas and Irwin Casterella (2019); Awa and Ojiabo (2016); Ramdani et al. (2009)
Internet	Internet; Broadband	7%	Bowen and Morris (2019); Arbore and Ordanini (2006)
Website	Web presence; Web portal; Web-based technologies	5%	Burgess (2016); Daryanto et al. (2013); Woolgar, Gomes, Vaux, Ezingard, & Grieve (1998)
Cloud computing	Cloud computing	4%	Karunagaran et al. (2019); Dincă et al. (2019); Sultan (2011)
Social media	Social Media	2%	Eid et al. (2019); Tajvidi and Karami (2017); Braojos-Gomez et al. (2015)
Other technologies	E.g. Industry 4.0; Internet of Things (IoT); Business Intelligence Systems	15%	Annosi et al. (2019); Puklavec et al. (2018); Sivathanu (2019)

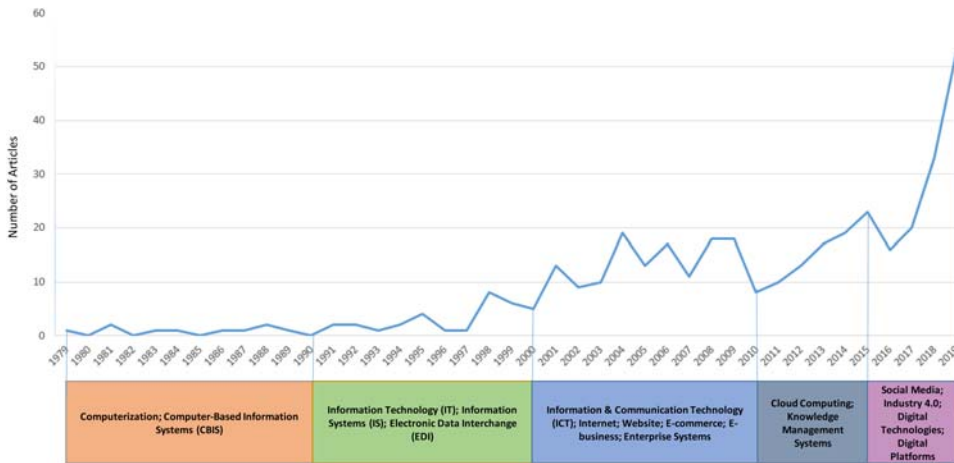


Figure 3. The evolution of the studied digital technologies.

(Davis, 1989) to explore the antecedents of digital innovation in SMEs. As these models can be limiting when explaining why and how SMEs carry out digital innovation, researchers have combined them with several other models (as highlighted in Table 4). In the small business context, TOE or Technology-Organization-Environment (Tornatzky et al., 1990) gained prominence in explaining the antecedents of digital innovation. This generic conceptualization allows researchers to choose from a wide range of determinants that could explain the factors influencing SMEs' intention, adoption, implementation, and usage of digital technologies. Recent research added the individual antecedents relating to the owners' and/or managers' characteristics, which was missing in studies using the TOE framework. Although the general digital innovation literature delineates organizational and individual uptake of digital technologies (Jeyaraj et al., 2006), studies in the small business context advocate that individual characteristics are essential antecedents for digital innovation in SMEs (e.g. AlBar & Hoque, 2019; Chang et al., 2012; Elbeltagi et al., 2013). Moreover, researchers have used or partly used the resource-based view (RBV) with other theories such as DOI and dynamic capabilities

Table 4. Influential theories and models used to examine digital innovation in SMEs.

Models and theories	Other variations	Illustrative references
Technology-Organization-Environment	TOE	AL-Shboul (2019); Awa and Ojiabo (2016); Ramdani et al. (2013)
	TOEP (Technology-Organization-Environment-Process)	Ahani et al. (2017)
	Individual-TOE	AlBar and Hoque (2019); Elbeltagi et al. (2013); Chang et al. (2012)
Diffusion of Innovation	DOI	Eid et al. (2019); Nguyen and Waring (2013); Nooteboom et al. (1992)
Technology Acceptance Model	TAM	Al-Bakri and Katsioloudes (2015)
	TAM, DOI, TOE	Kumar et al. (2017)
	TAM, Motivation Model; The Integrated Model of Technology Acceptance	Caniëls et al. (2015)
Resource-Based View (RBV) and Dynamic Capabilities	TAM; Information System Success Model	Lee and Kwon (2014)
	RBV	Uwizeyemungu et al. (2018); Chen et al. (2016); Caldeira and Ward (2003)
	RBV and DOI	Ruivo et al. (2013)
	Dynamic Capabilities	Eze and Chinedu-Eze (2018); Yunis et al. (2017)
Theory of Planned Behavior	RBV and Dynamic Capabilities	Adeniran and Johnston (2016)
	TPB	Grandon and Pearson (2004); Riemenschneider and McKinney (2002); Harrison et al. (1997)
	TPB and TAM	Riemenschneider et al. (2003)

to explore how SMEs exploit core competencies to gain competitive advantage. Although used by a limited number of studies, the RBV (Chen et al., 2016; Ko & Liu, 2019) and dynamic capabilities (Garbellano & Da Veiga, 2019; North et al., 2019) theories have not yet been employed to enrich the literature on the capabilities needed for organizations to achieve the desired digital innovation outcomes.

Context

Using the World Bank country classification (World Bank, 2018), our sample covers all 7 regions and 85 countries around the world (as shown in Table 5). In terms of regions, Europe and Central Asia is the most studied region followed by East Asia and Pacific region. Middle East and North Africa, South Asia, Sub-Saharan Africa regions seem to have lower number of studies. The least studied region with only 6 studies is Latin America and the Caribbean. In terms of economies, while most studies (75%) focus on high-income economies, only 28 studies were carried out in lower-middle-income economies and 2 studies in low-income economies. Before year 2001, none of the published studies covered any of the low-income and lower-middle-income economies. Up to 2011, only three studies covered lower-middle-income economies focusing on three countries namely India (Lal, 2002; Oyelaran-Oyeyinka & Lal, 2006), Bangladesh (Osterwalder, 2004), and Nigeria (Oyelaran-Oyeyinka & Lal, 2006). Since 2012, a number of studies covered countries such as Vietnam (Minh et al., 2017), Tunisia (Ben Arfi & Hikkerova, 2019), Sri Lanka (Senarathna et al., 2014), India (Kharub, 2019), Myanmar (Bala & Feng, 2019), and Cameroon (Ntwoku et al., 2017). Surprisingly, less attention has been given to studying low-income economies. The two countries studied in the low-income category are Uganda (Oyelaran-Oyeyinka & Lal, 2006) and Congo (Kabongo & Okpara, 2014). Thus, there is still much to know about digital innovation and SMEs in numerous geographical contexts. Although most of the studies focused more on contextual replications, there is still a need for more research that drives theoretical insights from these contexts.

Content

Having presented the results on the examined digital technologies, theories used, and the studied contexts, evidence on the content i.e. variables and relationships in our framework will be revealed as follows:

Table 5. Summary of literature search results on regions and countries covered.

Regions studied; Economies (Income) studied (Number of occurrences)	Countries studied (Number of occurrences)
East Asia and Pacific (76)	Antigua and Barbuda (1); Argentina (1); Australia (15); Austria (5); Azerbaijan (1);
Europe and Central Asia (155)	Bangladesh (1); Barbados (1); Belgium (5);
Latin America and the Caribbean (6)	Bolivia (1); Botswana (1); Brazil (1); Bulgaria (1); Cameroon (1); Canada (15);
Middle East and North Africa (16)	Czech Republic (2); Chile (4); China (7);
North America (55)	Colombia (2); Congo (1); Costa Rica (1); Croatia (1);
South Asia (14)	Denmark (7); Dominican Republic (1); Ecuador (1); Egypt (2); Finland (10);
Sub-Saharan Africa (15)	France (11); Fiji (1); Germany (17); Greece (8); Guyana (1); Hong Kong (6);
---	Hungary (2); India (13);
Low-income economies (2)	Indonesia (3); Iran (6); Ireland (11); Iceland (1); Italy (30); Jamaica (2); Japan (2);
Lower-middle-income economies (28)	Jordan (3); Kenya (1); Korea (3); Latvia (1); Lebanon (2); Liechtenstein (1);
Upper-middle-income economies (49)	Luxembourg (1); Macedonia (2); Malaysia (13); Malta (1); Mexico (2); Myanmar
High-income economies (249)	(1); Netherlands (7); New Zealand (7); Nigeria (7); Norway (3);
	Peru (1); Philippines (1); Poland (10); Portugal (6); Russian Federation (2);
	Romania (1); Saudi Arabia (3); Singapore (9); Slovak Republic (1); Slovenia (4);
	South Africa (7);
	South Korea (3); Spain (19); Sri Lanka (1); Sweden (9); Switzerland (4); Taiwan;
	(10); Thailand (5);
	Trinidad and Tobago (1); Tunisia (2); Turkey (7); UAE (4);
	Uganda (1); UK (51); USA (45); Uruguay (1); Venezuela (1); Vietnam (2)

Digital innovation antecedents

The majority of research in this field of research focused on the determinants of digital innovation in SMEs. Specifically, researchers explored and examined the factors facilitating and/or hindering SMEs' uptake of digital technologies. From reviewing the extant evidence, antecedents of digital innovation in SMEs can be categorized into individual, technological, organizational, and environmental determinants (e.g. Molla et al., 2006; Raymond, 2001; Wymer & Regan, 2011). Although researchers have examined numerous antecedents, this review highlights the antecedents that have been shown to significant.

Individual antecedents: The characteristics of the Chief Executive Officer (CEO) or the owner and/or manager influence digital innovation in SMEs. These are characteristics that describe the individuals responsible for the uptake of digital technologies (Jeyaraj et al., 2006). From reviewing the literature, seven antecedents were shown to influence digital innovation. These antecedents are knowledge and experience, education, attitude, motivation, age, gender, and entrepreneurial orientation of the owner and/or manager (research summary is highlighted in Table 6). Evidence suggests that SMEs are more likely to be engaged in digital innovation if their CEOs are aware of the potential benefits that could be generated from digital technologies. CEOs lacking the knowledge and experience in digital technologies are less likely to be involved in digital innovation (Thong & Yap, 1995). Moreover, studies have established that the level of CEOs' education is linked to their adoption of digital technologies. The more educated the CEO, the more likely they are aware of new technologies, and as a result the more likely they will be involved in digital innovation. Another important determinant is the CEO's attitude towards new technologies. Studies have demonstrated that CEOs forming positive attitudes towards digital technologies are more likely to adopt them. Also, CEOs motivation and enthusiasm about digital innovation can influence their decision. Researchers found that lack of enthusiasm as a barrier to technology adoption and diffusion (e.g. Molla et al., 2006). In addition, prior research showed that younger CEOs are more likely to be involved in digital innovation (Palvia & Palvia, 1999). Furthermore, although evidence is scarce, some studies confirmed that CEOs' gender is linked to their uptake of new technologies. Awa et al. (2015) found that male top executive to be more influential than female executives in the adoption of e-commerce. Lastly, CEOs' entrepreneurial orientation has been found to influence their decision on digital innovation.

Technological antecedents: These have been found to influence digital innovation in SMEs. These are characteristics that describe the digital technology (Jeyaraj et al., 2006). Five antecedents were identified to significantly influence the uptake of digital technologies including perceived usefulness, perceived ease-of-use, perceived compatibility, security and privacy, and trialability (research

Table 6. Owner/manager antecedents of digital innovation in SMEs.

Antecedents	Description	Illustrative references
Knowledge and Experience	Knowledge and awareness of what digital innovations could potentially offer (Thong & Yap, 1995)	AlBar and Hoque (2019); Chang et al. (2012); Raymond (2001)
Education	Owner and/or manager level of education	Ntwoku et al. (2017); Peltier et al. (2012); Levenburg et al. (2006)
Attitude	Forming a favorable or unfavorable attitude towards digital innovation (Karahanna, Straub, & Chervany, 1999)	Ahmad et al. (2015); Peltier et al. (2012); Caldeira and Ward (2003)
Motivation	Degree of enthusiasm and enjoyment of being involved in digital innovation (Davis, 1993)	Caniëls et al. (2015); Molla et al. (2006); Cragg and King (1993)
Age	Age of the owner and/or manager	Newby et al. (2014); Chuang et al. (2009); Palvia and Palvia (1999)
Gender	Gender of the owner and/or manager	Awa et al. (2015); Chuang et al. (2009); Palvia and Palvia (1999)
Entrepreneurial Orientation	'the willingness to take business related risks, the willingness to be proactive when competing with other firms, and the willingness to innovate, i.e. to favor change and innovation in order to obtain competitive advantage' (Naman & Slevin, 1993, p. 143)	Yunis et al. (2017); Abebe (2014); Aragon-Correa and Cordon-Pozo (2005)

Table 7. Technological antecedents of digital innovation in SMEs.

Antecedents	Description	Illustrative references
Perceived Usefulness	'The degree to which an innovation is perceived as being better than its precursor' (Moore & Benbasat, 1991, p. 195)	AlBar and Hoque (2019); Premkumar and Roberts (1999); Cragg and King (1993)
Perceived Ease-of-use	'The degree to which an innovation is perceived as being difficult to use' (Moore & Benbasat, 1991, p. 195)	Almajali et al. (2016); Premkumar and Roberts (1999); Sullivan and Kang (1999)
Perceived Compatibility	'The degree to which an innovation is perceived as being consistent with existing values, needs, and past experiences of potential adopters' (Moore & Benbasat, 1991, p. 195)	Ahani et al. (2017); Premkumar and Roberts (1999); Sullivan and Kang (1999)
Security and Privacy	The degree to which a digital technology is perceived as reliable and trustworthy	Kim et al. (2017); Riemenschneider and McKinney (2002)
Trialability	'The degree to which an innovation can be experimented with before adoption' (Moore & Benbasat, 1991, p. 195)	Ramdani et al. (2013); Ramdani et al. (2009); Kendall et al. (2001)

summary is highlighted in Table 7). Evidence suggests that SMEs are more likely to be engaged in digital innovation if they perceive that the new technologies will deliver benefits that supersede the benefits from their existing technologies. In addition, new technologies that are perceived to be complex create greater uncertainty regarding their successful assimilation and could deter SMEs from acquiring them (Premkumar & Roberts, 1999). Studies have also shown that SMEs are more likely to be engaged with new technologies that are perceived to be compatible with SMEs' existing values, needs, and past experiences. Furthermore, studies have shown that SMEs are highly unlikely to be involved with technologies that are not perceived to be trustworthy. Lastly, empirical evidence confirm that SMEs will engage with digital technologies that can be experimented with before investing since this provides SMEs with the opportunity to see what these technologies offer in terms of product, process, and business model innovation.

Organizational antecedents: These influence SMEs decision to get involved in digital innovation. From reviewing the extant evidence, three antecedents were shown to significantly influence digital innovation in SMEs. These antecedents are top management support, organizational readiness, and organizational culture (research summary is highlighted in Table 8). Prior studies have found that top management to be critical in creating a supportive climate for digital innovation. In the small business context, the CEO is the decision maker and his/her support is paramount. Another important determinant of digital innovation in SMEs is their organizational readiness. Although fewer studies have established the link between organizational readiness and digital innovation (e.g. Hajli et al., 2014; Ramdani et al., 2013), three dimensions have been confirmed to characterize organizational readiness namely human, technological, and financial resources. SMEs are more likely to be involved in digital innovation if their employees accept new technologies, their existing infrastructure allows for digital innovation, and they have the financial means to invest in such technologies. Moreover, studies show that organizational culture that is flexible to change is more likely to facilitate digital innovation in SMEs as opposed to a culture that is resistant to change.

Table 8. Organizational antecedents of digital innovation in SMEs.

Antecedents	Description	Illustrative references
Management Support	Degree of willingness and commitment of the top management	AlBar and Hoque (2019); Ramdani et al. (2009); Premkumar and Roberts (1999)
Organizational Readiness	Degree of human, technological, and financial resources availability	Ramdani et al. (2013); Mehrkens et al. (2001); Iacovou et al. (1995)
Human		Ahani et al. (2017); Scupola (2009); Yap et al. (1992)
Technological		Choshin and Ghaffari (2017); Scupola (2009); Caldeira and Ward (2003)
Financial		Ahani et al. (2017); Riemenschneider and McKinney (2002); Yap et al. (1992)
Organizational Culture	Degree of flexibility to change as a result of being involved in digital innovation	AlBar and Hoque (2019); Shah Alam (2009); Fink (1998)

Table 9. Environmental antecedents of digital innovation in SMEs.

Antecedents	Description	Illustrative references
Competitive Pressure	Extent of losing customers to competitors if digital innovation is not carried out	Ahani et al. (2017); Kuan and Chau (2001); Cragg and King (1993)
Partners Network	Degree of digital sophistication among a firm's trading partners	Ahmad et al. (2015); Chong (2008); Premkumar and Roberts (1999)
Government Support	Degree of support provided in terms of informational campaigns, financial incentives, tax breaks among other initiatives (Scupola, 2003)	AlBar and Hoque (2019); Scupola (2009); Kuan and Chau (2001)
Clients Demands	Degree to which customers are demanding the uptake of digital technologies for doing business with them	Ahani et al. (2017); Choshin and Ghaffari (2017); Ramsey et al. (2008)
Vendor Support	Extent of having vendor's technical support when carrying out digital innovation	Kim et al. (2017); Yap et al. (1992)
Market Scope	Degree to which a firm's scope of operations is local, regional, and/or global	Caniëls et al. (2015); Ramdani et al. (2013)

Environmental antecedents: Digital innovation in SMEs is influenced by environmental antecedents, which are characteristics that describe the external environment (Jeyaraj et al., 2006). Six antecedents were shown to significantly influence digital innovation in SMEs. These are competitive pressure, partners' network, government support, clients' demands, vendor support and market scope (research summary is highlighted in Table 9). Evidence suggests that SMEs under competitive threats are more likely to resort to digital innovation to lessen the extent of losing customers. Moreover, prior studies have confirmed that SMEs are more likely to be involved in digital innovation if their trading partners have a high degree of digital sophistication. Also, researchers have confirmed the role of government support in SMEs' uptake of digital technologies including awareness campaigns, financial incentives, and tax breaks (Scupola, 2003). Furthermore, studies have shown that one of the critical environmental antecedents is meeting clients' demands through digital innovation in order for SMEs to do business with these clients. In addition, evidence shows that SMEs are more likely to be involved with digital innovation when technology suppliers are willing to provide the needed technical support. Otherwise, SMEs will not engage in digital innovation due to lacking internal technical support, and the costs associated with hiring external consultants. Lastly, SMEs are eager to be involved in digital innovation when their market scope gets larger, thus requiring new technologies to facilitate local, regional and international operations.

Digital innovation process

The digital innovation process has been portrayed in the general innovation literature to comprise different stages that firms go through when conducting digital innovation (Fichman et al., 2014). From reviewing the extent evidence, studies focus on four stages that characterize the process of digital innovation in SMEs namely intention, adoption, implementation and usage (illustrative references are provided in Table 10). The vast majority of studies focused on the adoption stage, while a limited number of empirical studies explored more than one stage (e.g. De Waal & Knott, 2013; Lin 2014; Newby et al., 2014; Nguyen & Waring, 2013). Early studies have questioned the simple progressive path suggested by 'stages of growth' models (e.g. Levy & Powell, 2003; Martin & Matlay, 2001). However, less attention has been paid to exploring the phases SMEs go through for a particular type of digital innovation (i.e. product, organizational, and business model). Also, much can be studied in relation to the activities deployed in each phase, the relationships between phases,

Table 10. Stages of digital innovation in SMEs.

Stages	Illustrative references
Intention	Kim et al. (2017); Levenburg et al. (2006); Thong (1999)
Adoption	AlBar and Hoque (2019); Ramdani et al. (2009); Thong (1999)
Implementation	Newby et al. (2014); Yee-Loong Chong et al. (2009); Panizzolo (1998)
Usage	Eggers et al. (2017); Shah Alam (2009)

Table 11. Outcomes of digital innovation in SMEs.

Outcomes	Measures	Illustrative references
Organizational Performance	Profitability	Bala and Feng (2019); Harrigan et al. (2009)
	Customer Satisfaction	Scuotto et al. (2017); Harrigan et al. (2009); Iacovou et al. (1995)
	Competitiveness	Adeniran and Johnston (2016); Riemenschneider and McKinney (2002); Sullivan and Kang (1999)
	Internationalization	Pergelova et al. (2019); Harrigan et al. (2009)
Business Process Performance	Innovation (Product, Process, and Business Model)	Peón and Martínez-Filgueira (2020); Bouwman et al. (2018)
	Process	Chen et al. (2016); Yang and Su (2009)
	Efficiency	Scupola (2009); Iacovou et al. (1995)
	Cost Reduction	Tan et al. (2010); Iacovou et al. (1995)

and the different pathways SMEs undertake. Activities can be identified for each phase depending on the type of innovation and the managerial issues faced (Fichman et al., 2014). Also, it is essential to examine the relationships between phases and whether a particular digital innovation strengthens and/or weakens the transition from one phase to the next. Molla et al. (2006) suggest that researchers may use path dependency to explore the paths that SMEs really undertake in their digital innovation journey.

Digital innovation outcomes

As highlighted in Table 11, digital innovation impact SMEs’ performance leading to organizational and business process performance outcomes. While many studies have examined the overall organizational impact of digital innovation, fewer studies assessed digital innovation impacts on specific business processes. Among the organizational performance measures are profitability, customer satisfaction, competitiveness, and internationalization. Innovation (product, process, and business model) is one of the least studied outcomes. Moreover, three operational impacts have been the subject of measurement such as improving organizational processes, increasing efficiency, and reducing costs. Despite the numerous potential benefits that could be realized from digital innovation in SMEs, research is still scarce on the impact of emerging digital technologies such as IoT, artificial intelligence (AI), machine learning, and big data analytics. Also, very little is known on which digital technologies impact small business performance, and which fall short and why. One of the less explored aspects in this literature is the organizational capabilities facilitating the delivery of specific digital innovation outcomes. Furthermore, digital innovation outcomes such as SME performance have been shown to be directly affected by digital innovation antecedents (e.g. Bala & Feng, 2019; Soto-Acosta et al., 2018). However, less is known on the antecedents leading to product, process and business model innovation outcomes.

Mediators and/or moderators

Some studies suggest that digital innovation process-outcomes relationship is not straightforward for two reasons. First, some of the antecedents discussed earlier have been found to mediate and/or moderate this relationship. For example, Chen et al. (2016) found that the perceived usefulness of a portal moderates the relationship between portal interface and organizational performance. Second, some other variables were also found to mediate and/or moderate this relationship including size (Shin, 2006; Verbano & Crema, 2016), location (Verbano & Crema, 2016), industry (Cataldo et al., 2020; Daniel et al., 2002; Rangaswamy & Nair, 2012; Shin, 2006), and the existing digital infrastructure (Awa et al., 2015). Other studies have shown that certain organizational capabilities such as marketing capabilities (Tajvidi & Karami, 2017), and absorptive capacity (Francalanci & Morabito, 2008) also mediate this relationship. Although researchers have started gathering evidence on the mediators and/or moderators of digital innovation process-outcomes association, it is still unclear which variables play intervening roles in this relationship.

Discussion

One of the key results from this review is that digital innovation in SMEs is influenced by a configuration of antecedents and has different outcomes depending on the digital technology being studied. Thus far, there is no consensus on the determinants of particular digital technologies, nor the digital outcomes. This is due to studying a wide range of digital technologies in different contexts using different theoretical underpinnings. This complexity is amplified when researcher study a group of digital technologies that have different features and functionalities using aggregate terms such as ICT, IT, Industry 4.0, digital technologies among other terms. Researcher examining groups of technologies with common features and functionalities such as enterprise systems will add to the existing knowledge. However, researchers studying digital technologies in groups that do not have common features and functionalities will hamper the progress in this field of research. To identify and determine the antecedents and outcomes of a particular digital innovation, researchers need to specify and differentiate between the digital technologies they intend to empirically examine.

Another key result from this review is that a configuration of individual, technological, organizational, and environmental antecedents influences digital innovation process and outcomes. The review provides a synthesis of the most prominent antecedents, stages, and outcomes of digital innovation in SMEs. However, it is not yet clear which configuration of antecedents influences which stages of digital innovation process. This confusion could be due to not specifying the digital technologies under study as well as different theoretical underpinnings used in different contexts. Thus, it is critical that researchers accumulate evidence on specific technologies highlighting the configuration of antecedents relating to specific technologies, and the stages they influence.

In the small business context, the digital innovation process comprises four stages namely intention, adoption, implementation, and usage. The vast majority of the studies in this field focused on only one stage. While most studies in this field focus on the adoption stage, a limited number of studies explored the other stages. Three reasons could explain this trend. First, the adoption of digital technologies is highly practical and can be easily measured. Second, exploring the implementation stage requires employing qualitative studies (e.g. Gengatharen & Standing, 2005; Sharma et al., 2012), which usually take longer to conduct. Third, many studies in this area have examined other dependent variables such as success (DeLone, 1988), practical use (e.g. Oh et al., 2009), overall IS effectiveness (e.g. de Guinea et al., 2005), and IT appropriateness (e.g. Khazanchi, 2005). Moreover, very few studies explored more than one stage of digital innovation process (e.g. Molla et al., 2006; Newby et al., 2014; Nguyen & Waring, 2013). We call for more studies to explore multiple stages of digital innovation process.

Digital innovation impacts SMEs' organizational and business process performance. Studies have focused more on the organizational performance and less on specific business process performance. Also, evidence is inconclusive as to which digital technologies can generate which outcomes, and the literature provides little clarity on when SMEs can achieve certain digital innovation outcomes. It is critical for future studies to examine what outcomes can be achieved from different stages of digital innovation process. This review acknowledges the intervening roles played by antecedent, mediators and/or moderators in the process-outcomes relationship. Further evidence is needed on these variables and how SMEs can achieve more organizational and business process performance outcomes.

Future research

Our results suggest several avenues for future research in relation to theory, context, method and content. Although these areas are interlinked, we draw them out by focusing on key research gaps and corresponding research questions (summarized in Table 12).

Table 12. Future research directions for digital innovation in SMEs research.

Theory	How can extent theory be developed or enhanced to help explain digital innovation in SMEs? Which theories from organizational science have the potential for conceptual contributions? Which organizational theories can be used to better explain digital innovation in SMEs? Should new theories be developed?
Context	What is the status and prospects of digital innovation and SMEs in America and the Caribbean region and in low-income economies? What are the similarities and differences of digital innovation in SMEs among low-income economies? What are the differences of digital innovation in SMEs across nations? How does the context shape digital innovation in SMEs among low-income economies? What geo-political and socio-political antecedents influence digital innovation in SMEs? What are the institutional pressures and how they differ from country to country?
Method	What innovative methods from other disciplines can be used to explore digital innovation in SMEs more effectively? What methods can be used to compare digital innovation in SMEs across nations? How can current understanding of digital innovation in SMEs be enhanced using other methods such as longitudinal studies and ethnographic research?
Content	
Digital innovation antecedents	What are the antecedents of emerging digital technologies (such as IoT, AI, machine learning, and big data analytics) in SMEs? What are the similarities and differences of antecedents influencing different digital technologies? What combinations of antecedents are needed for SMEs' initiation, adoption, implementation, and usage of digital technologies? What are the antecedents that have a direct impact on digital innovation outcomes? What are the antecedents that moderate and/or mediate digital innovation process-outcome relationship?
Digital innovation process	What is the process of digital innovation for emerging digital technologies in SMEs? What is the process for different types of digital innovation (product, organizational, and business model)? What are the similarities and differences of digital innovation process for different digital technologies? What are the linkages between different digital innovation stages? How digital innovation in SMEs can help achieve product, process, and business models innovations?
Digital innovation outcomes	What are the outcomes resulting from digital innovation of emerging technologies in SMEs? How do these outcomes compare to outcomes of studied digital innovations? Which are the digital technologies that can generate organizational and business process outcomes? What organizational capabilities can facilitate certain outcomes? What are the variables mediating and/or moderating digital innovation process-outcomes relationship?

Theory

From reviewing the theoretical underpinnings of digital innovation in SMEs research, conceptual contributions are limited, which in turn may hamper the progress of this field of research. Most of these contributions are either contextually-driven (e.g. Martin & Matlay, 2001; Stroeken, 2001), or technologically-driven (e.g. Metaxiotis, 2009; Thakkar et al., 2008). Morgan-Thomas (2016), is the exception here, advocating a complete rethinking of digital innovation in small business context by calling on the emerging field of technology-in-practice. Thus, we call for contributions that will build a theoretical grounding that is distinct from what already exists in the digital innovation in SMEs literature.

As previously discussed, the most influential theories are TOE (e.g. Awa & Ojiabo, 2016), DOI (e.g. Nguyen & Waring, 2013), TAM (e.g. Al-Bakri & Katsioloudes, 2015), RBV and dynamic capabilities (e.g. Chen et al., 2016), and TPB (e.g. Grandon & Pearson, 2004). TOE is especially pertinent across the majority of studies focusing on the antecedents of digital innovation. The other theories have been used to either explore the antecedents or examine the capabilities needed for certain digital technologies (e.g. Chao & Chandra, 2012; Chen et al., 2016). For future studies, we advocate a much broader approach to developing useful explanatory theory for digital innovation in SMEs.

This field of research could be advanced by drawing on theoretical perspectives from organizational science literature. For example, Van Beijsterveld and Van Groenendaal (2016) used contingency theory to show how SMEs handle off-the-shelf ERP system misfits in Dutch SMEs. Moreover, Francalanci and Morabito (2008) used absorptive capacity to examine the link between digital technology and business performance. Continuing with learning perspectives, bricolage was used by Ferneley and Bell (2006) to show how SMEs exploit the can-do approach to digital technology that is particular to small businesses.

Context

Because less developed economies generally lack the resources and capabilities (Qureshi et al., 2009), we call for more research on the status and prospects of SMEs' digital innovation in low-income economies. This will contribute to our understanding of the overall impact of digital technologies on development (Qureshi, 2015). Also, this will help draw a better picture on similarities and differences of digital innovation in SMEs not only among low-income economies, but also across nations. Cross-country comparative analysis of digital innovation in SMEs is still in its infancy. Wielicki and Arendt (2010) conducted a comparative study of developed economies namely US and European SMEs in their perception of digital technology implementation barriers. Also, Lee and Lan (2011) conducted a comparative study of two high-income economies in East Asia namely Taiwan and Hong Kong to understand the role of government in facilitating digital innovation in SMEs. Instead of contextual replications, researchers are encouraged to dig deeper into contextual intricacies that shape digital innovation in SMEs among low-income economies. Andoh-Baidoo (2017) argues that ICT for development researchers could make theoretical and empirical contributions through 'context-specific theorizing.' He argues that a specific context-based research problem could be addressed by seeking to develop a theory with variables that capture the context. In addition to technology, IT users, and IT usage, the author argues that culture, geo-political, and socio-political contexts are also important for advancing research. Although organizational culture has been included in previous studies, geo-political and socio-political contexts are yet to be examined. Finally, theories such as institutional theory (Coffey et al., 2013) can help gain a deeper and more nuanced understanding of digital innovation in SMEs across national contexts.

Method

There are several ways to improve SMEs' digital innovation research methodologically. In designing future studies, researchers may consider going beyond the TOE framework to include individual antecedents, accounting for more than one stage of the digital innovation process, and examining different digital innovation outcomes. In comparing digital innovation in SMEs across nations, researchers in this area could collaborate by developing and running a standard survey that captures elements described in our framework. Although quantitative approaches can provide substantive insights on digital innovation in SMEs research, these approaches are rarely sufficient in explaining the workings of small business and the conditions that facilitate digital innovation. Thus, researcher could employ more qualitative methods that are longitudinal in nature and ethnography-oriented methods to gain a deeper understanding of digital innovation in SMEs.

Content

Future research needs to examine digital technologies in a 'disaggregated manner' (Ilavarasan, 2017) by looking at specific digital technologies' antecedents, process, and outcomes. Although starting to gather pace, studies of emerging digital technologies in SMEs (e.g. Kumar et al., 2017; Pérez-González et al., 2017) are still scarce. Further research is needed to explore the antecedents, the process, and

outcomes of emerging digital technologies in SMEs. Also, it is worth investigating how the findings on emerging digital technologies compare with existing evidence on digital technologies that have already been examined.

While much of the literature focuses on the antecedents of digital innovation, further research is still needed to clarify the different combination of antecedents for different digital technologies. Also, empirical studies are needed to explore which combinations of antecedents are needed for which stages of digital innovation process. It will be insightful for future research to provide empirical evidence on the antecedents needed for SMEs to go through a particular stage or multi-stages of the digital innovation process.

Existing contributions on the digital innovation process show fragmented insights and do not attempt to provide an integrated perspective into the key stages and the associations between them. Although some researchers have explored more than one stage, the linkages between these stages are still unexplored. Thus, identifying the key stages, their sequences, and linkages warrants further investigation. We call for further research to unravel the activities associated with the digital innovation process and the paths undertaken by SMEs to undertake digital innovation in practice. In particular, qualitative and longitudinal research is needed to explore how digital innovation in SMEs can help achieve product, process, and business models innovation.

Despite the importance of digital innovation outcomes, the associated variables have received very little attention in the literature. Thus, this presents a real opportunity for future research. From our review, it is still unclear which digital technologies can help generate which digital innovation outcomes. Also, evidence is scarce on the activities and capabilities facilitating specific digital innovation outcomes. Therefore, it is essential that future research examines the process-outcomes relationship and the intervening role of mediators and/or moderators of this relationship.

Conclusion

This paper presents a comprehensive systematic review of the literature on digital innovation in SMEs. Selected papers have been evaluated to identify the digital technologies, theories, contextual orientations, and the content under study. The literature has been synthesized into a conceptualization advocating that digital innovation in SMEs is driven by a configuration of four sets of antecedents (i.e. individual, technological, organizational, and environmental), goes through a four stages process (i.e. intention, adoption, implementation, and usage), and leads to two outcomes (organizational and business process performance). However, this review has limitations in relation to creativity and publication bias. Our review does not escape from the typical limitations of systematic reviews, where creativity is limited and articles are excluded as a result of applying ridged criteria (Easterby-Smith et al., 2012; Wang & Chugh, 2013). Our analysis is limited to papers in peer-reviewed ABS journals, which excludes other peer-reviewed journals. Also, our review suffers from publication bias as we ignored work published in unrecognized outlets, books and conferences. This review emphasized that research in digital innovation and SMEs is highly diverse and significant knowledge gaps exist in relation to theory, context, method, and content. Future research agenda has been drawn by highlighting the key topics and associated research questions that could progress this field of research.

This review makes several contributions to the theory of digital innovation in general and ICT for development in particular. We have emphasized that digital innovation in the small business context need conceptual contributions that are distinct from what already exists to move the field forward. We developed a theoretical framework showing that digital innovation in SMEs is driven by a configuration of antecedents, goes through different stages, and leads to various outcomes. Moreover, this review makes contributions to the theory of ICT for development as it sheds light on the empirical evidence that strengthens the association of digital innovation with outcomes relating socio-economic development. This review shows that digital innovation in SMEs has several outcomes including profitability, competitiveness and internationalization. Finally, this review shows

that a limited number of studies have been conducted in low-income economies and calls for more empirical studies to further our understanding of the role of digital innovation for development.

The findings of this review are relevant for owner and/or managers of SMEs, technology vendors and/or consultants, and policy makers. Owner and/or managers of SMEs can use the findings of this review to understand and develop the business case for digital innovation, and be aware of the factors that could facilitate the uptake of digital technologies. Technology vendors and/or consultants could use our framework to demonstrate how SMEs carry out digital innovation. For policy makers, existing technology awareness programs, training and incentives need to be revised in light with findings presented in this review.

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References

- Abebe, M. (2014). Electronic commerce adoption, entrepreneurial orientation and small- and medium-sized enterprise (SME) performance. *Journal of Small Business and Enterprise Development*, 21(1), 100–116. <https://doi.org/10.1108/JSBED-10-2013-0145>
- ABS. (2015). *Academic journal quality guide*. Chartered Association of Business Schools.
- Adeniran, T. V., & Johnston, K. A. (2016). The impacts of ICT utilisation and dynamic capabilities on the competitive advantage of South African SMEs. *International Journal of Information Technology and Management*, 15(1), 59–89. <https://doi.org/10.1504/IJITM.2016.073915>
- Ahani, A., Rahim, N. Z. A., & Nilashi, M. (2017). Forecasting social CRM adoption in SMEs: A combined SEM-neural network method. *Computers in Human Behavior*, 75(10), 560–578. <https://doi.org/10.1016/j.chb.2017.05.032>
- Ahmad, S. Z., Abu Bakar, A. R., Faziharudean, T. M., & Mohamad Zaki, K. A. (2015). An empirical study of factors affecting e-commerce adoption among small- and medium-sized enterprises in a developing country: Evidence from Malaysia. *Information Technology for Development*, 21(4), 555–572. <https://doi.org/10.1080/02681102.2014.899961>
- Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckmann (Eds.), *Action control*. SSSP Springer series in Social Psychology (pp. 11–39). Springer.
- Al-Bakri, A. A., & Katsioloudes, M. I. (2015). The factors affecting e-commerce adoption by Jordanian SMEs. *Management Research Review*, 38(7), 726–749. <https://doi.org/10.1108/MRR-12-2013-0291>
- Al-Shboul, M. A. (2019). Towards better understanding of determinants logistical factors in SMEs for cloud ERP adoption in developing economies. *Business Process Management Journal*, 25(5), 887–907. <https://doi.org/10.1108/BPMJ-01-2018-0004>
- AlBar, A. M., & Hoque, M. R. (2019). Factors affecting the adoption of information and communication technology in small and medium enterprises: A perspective from rural Saudi Arabia. *Information Technology for Development*, 25(4), 715–738. <https://doi.org/10.1080/02681102.2017.1390437>
- Almajali, D. A., Masa'deh, R. E., & Tarhini, A. (2016). Antecedents of ERP systems implementation success: A study on Jordanian healthcare sector. *Journal of Enterprise Information Management*, 29(4), 549–565. <https://doi.org/10.1108/JEIM-03-2015-0024>
- Andoh-Baidoo, F. K. (2016). Organizational information and communication technologies for development. *Information Technology for Development*, 22(2), 193–204. <https://doi.org/10.1080/02681102.2016.1160703>
- Andoh-Baidoo, F. K. (2017). Context-specific theorizing in ICT4D research. *Information Technology for Development*, 23(2), 195–211. <https://doi.org/10.1080/02681102.2017.1356036>
- Annosi, M. C., Brunetta, F., Monti, A., & Nati, F. (2019). Is the trend your friend? An analysis of technology 4.0 investment decisions in agricultural SMEs. *Computers in Industry*, 109, 59–71. <https://doi.org/10.1016/j.compind.2019.04.003>
- Aragon-Correa, J. A., & Cordon-Pozo, E. (2005). The influence of strategic dimensions and the environment on the introduction of internet as innovation into small and medium-sized enterprises. *Technology Analysis and Strategic Management*, 17(2), 205–218. <https://doi.org/10.1080/09537320500088856>
- Arbore, A., & Ordanini, A. (2006). Broadband divide among SMEs: The role of size, location and outsourcing strategies. *International Small Business Journal: Researching Entrepreneurship*, 24(1), 83–99. <https://doi.org/10.1177/0266242606059781>
- Awa, H. O. (2019). Some antecedent factors that shape actors' adoption of enterprise systems. *Enterprise Information Systems*, 13(5), 576–600. <https://doi.org/10.1080/17517575.2018.1466368>
- Awa, H. O., Baridam, D. M., & Nwibere, B. M. (2015). Demographic determinants of electronic commerce (EC) adoption by SMEs: A twist by location factors. *Journal of Enterprise Information Management*, 28(3), 326–345. <https://doi.org/10.1108/JEIM-10-2013-0073>
- Awa, H. O., & Ojiabo, O. U. (2016). A model of adoption determinants of ERP within TOE framework. *Information Technology and People*, 29(4), 901–930. <https://doi.org/10.1108/ITP-03-2015-0068>
- Bala, H., & Feng, X. (2019). Success of small and medium enterprises in Myanmar: Role of technological, organizational, and environmental factors. *Journal of Global Information Technology Management*, 22(2), 100–119. <https://doi.org/10.1080/1097198X.2019.1603511>
- Bandara, W., Furttmueller, E., Gorbacheva, E., Miskon, S., & Beekhuyzen, J. (2015). Achieving rigor in literature reviews: Insights from qualitative data analysis and tool-support. *Communications of the Association for Information Systems*, 37(1), 154–204. <https://doi.org/10.17705/1CAIS.03708>
- Ben Arfi, W., & Hikkerova, L. (2019). Corporate entrepreneurship, product innovation, and knowledge conversion: The role of digital platforms. *Small Business Economics*, <https://doi.org/10.1007/s11187-019-00262-6>

- Biswas, S., & Irwin Casterella, G. (2019). Does conventional wisdom apply? An enterprise system sourcing decision for a retail business in Fiji. *Communications of the Association for Information Systems*, 44(1), 141–151. <https://doi.org/10.17705/1CAIS.04406>
- Bouwman, H., Nikou, S., Molina-Castillo, F. J., & de Reuver, M. (2018). The impact of digitalization on business models. *Digital Policy, Regulation and Governance*, 20(2), 105–124. <https://doi.org/10.1108/DPRG-07-2017-0039>
- Bowen, R., & Morris, W. (2019). The digital divide: Implications for agribusiness and entrepreneurship. Lessons from Wales. *Journal of Rural Studies*, 72, 75–84. <https://doi.org/10.1016/j.jrurstud.2019.10.031>
- Braojos-Gomez, J., Benitez-Amado, J., & Llorens-Montes, F. J. (2015). How do small firms learn to develop a social media competence? *International Journal of Information Management*, 35(4), 443–458. <https://doi.org/10.1016/j.ijinfomgt.2015.04.003>
- Burgess, S. (2016). Representing small business web presence content: The web presence pyramid model. *European Journal of Information Systems*, 25(2), 110–130.
- Caldeira, M. M., & Ward, J. M. (2003). Using resource-based theory to interpret the successful adoption and use of information systems and technology in manufacturing small and medium-sized enterprises. *European Journal of Information Systems*, 12(2), 127–141. <https://doi.org/10.1057/palgrave.ejis.3000454>
- Caniëls, M. C., Lenaerts, H. K., & Gelderman, C. J. (2015). Explaining the internet usage of SMEs: The impact of market orientation, behavioural norms, motivation and technology acceptance. *Internet Research*, 25(3), 358–377. <https://doi.org/10.1108/IntR-12-2013-0266>
- Cataldo, A., Pino, G., & McQueen, R. J. (2020). Size matters: The impact of combinations of ICT assets on the performance of Chilean micro, small and medium enterprises. *Information Technology for Development*, 26(2), 292–315. <https://doi.org/10.1080/02681102.2019.1684870>
- Chan, C. M., Teoh, S. Y., Yeow, A., & Pan, G. (2019). Agility in responding to disruptive digital innovation: Case study of an SME. *Information Systems Journal*, 29(2), 436–455. <https://doi.org/10.1111/isj.12215>
- Chang, S. I., Hung, S. Y., Yen, D., & Lee, P. J. (2012). Critical factors of ERP adoption for small- and medium-sized enterprises: An empirical study. *Journal of Global Information Management*, 18(3), 205–230. <https://doi.org/10.4018/978-1-61350-480-2.ch009>
- Chao, C. A., & Chandra, A. (2012). Impact of owner's knowledge of information technology (IT) on strategic alignment and IT adoption in US small firms. *Journal of Small Business and Enterprise Development*, 19(1), 114–131. <https://doi.org/10.1108/14626001211196433>
- Chege, S. M., Wang, D., & Suntu, S. L. (2020). Impact of information technology innovation on firm performance in Kenya. *Information Technology for Development*, 26(2), 316–345. <https://doi.org/10.1080/02681102.2019.1573717>
- Chen, Y. Y. K., Jaw, Y. L., & Wu, B. L. (2016). Effect of digital transformation on organisational performance of SMEs: Evidence from the Taiwanese textile industry's web portal. *Internet Research*, 26(1), 186–212. <https://doi.org/10.1108/IntR-12-2013-0265>
- Chong, S. (2008). Success in electronic commerce implementation: A cross-country study of small and medium-sized enterprises. *Journal of Enterprise Information Management*, 21(5), 468–492. <https://doi.org/10.1108/17410390810904247>
- Choshin, M., & Ghaffari, A. (2017). An investigation of the impact of effective factors on the success of e-commerce in small- and medium-sized companies. *Computers in Human Behavior*, 66(1), 67–74. <https://doi.org/10.1016/j.chb.2016.09.026>
- Chuang, T. T., Nakatani, K., & Zhou, D. (2009). An exploratory study of the extent of information technology adoption in SMEs: An application of upper echelon theory. *Journal of Enterprise Information Management*, 22(1/2), 183–196. <https://doi.org/10.1108/17410390910932821>
- Coffey, P., Tate, M., & Toland, J. (2013). Small business in a small country: Attitudes to “green” IT. *Information Systems Frontiers*, 15(5), 761–778. <https://doi.org/10.1007/s10796-013-9410-4>
- Cragg, P. B., & King, M. (1993). Small-firm computing: Motivators and inhibitors. *MIS Quarterly*, 17(1), 47–60. <https://doi.org/10.2307/249509>
- Daniel, E., Wilson, H., & Myers, A. (2002). Adoption of e-commerce by SMEs in the UK: Towards a stage model. *International Small Business Journal: Researching Entrepreneurship*, 20(3), 253–270. <https://doi.org/10.1177/0266242602203002>
- Daryanto, A., Khan, H., Matlay, H., & Chakrabarti, R. (2013). Adoption of country-specific business websites. *Journal of Small Business and Enterprise Development*, 20(3), 650–660. <https://doi.org/10.1108/JSBED-04-2013-0048>
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340. <https://doi.org/10.2307/249008>
- Davis, F. D. (1993). User acceptance of information technology: System characteristics, user perceptions and behavioral impacts. *International Journal of Man-Machine Studies*, 38(3), 475–487. <http://doi.org/10.1006/imms.1993.1022>
- de Guinea, A. O., Kelley, H., & Hunter, M. G. (2005). Information systems effectiveness in small businesses: Extending a Singaporean model in Canada. *Journal of Global Information Management*, 13(3), 55–79. <https://doi.org/10.4018/jgim.2005070104>
- DeLone, W. H. (1988). Determinants of success for computer usage in small business. *MIS Quarterly*, 12(1), 51–61. <https://doi.org/10.2307/248803>

- Denyer, D., & Tranfield, D. (2009). Producing a systematic review. In D. Buchanan & A. Bryman (Eds.), *The Sage handbook of organizational research methods* (pp. 671–689). Sage.
- De Waal, G. A., & Knott, P. (2013). Innovation tool adoption and adaptation in small technology-based firms. *International Journal of Innovation Management*, 17(3), 1–19. <https://doi.org/10.1142/S1363919613400124>
- Dincă, V. M., Dima, A. M., & Rozsa, Z. (2019). Determinants of cloud computing adoption by Romanian SMEs in the digital economy. *Journal of Business Economics and Management*, 20(4), 798–820. <https://doi.org/10.3846/jbem.2019.9856>
- Easterby-Smith, M., Thorpe, R., & Jackson, P. R. (2012). *Management research*. Sage.
- Eggers, F., Hatak, I., Kraus, S., & Niemand, T. (2017). Technologies that support marketing and market development in SMEs—Evidence from social networks. *Journal of Small Business Management*, 55(2), 270–302. <https://doi.org/10.1111/jsbm.12313>
- Eid, R., Abdelmoety, Z., & Agag, G. (2019). Antecedents and consequences of social media marketing use: An empirical study of the UK exporting B2B SMEs. *Journal of Business & Industrial Marketing*, 35(2), 284–305. <https://doi.org/10.1108/JBIM-04-2018-0121>
- Elbeltagi, I., Al Sharji, Y., Hardaker, G., & Elsetouhi, A. (2013). The role of the owner-manager in SMEs' adoption of information and communication technology in the United Arab Emirates. *Journal of Global Information Management*, 21(2), 23–50. <https://doi.org/10.4018/jgim.2013040102>
- European Commission. (2016). *What is an SME?* Retrieved January 2018 from http://ec.europa.eu/growth/smes/businessfriendly-environment/sme-definition/index_en.htm
- Eze, S. C., & Chinedu-Eze, V. C. (2018). Examining information and communication technology (ICT) adoption in SMEs. *Journal of Enterprise Information Management*, 31(2), 338–356. <https://doi.org/10.1108/JEIM-12-2014-0125>
- Fariselli, P., Oughton, C., Picory, C., & Sugden, R. (1999). Electronic commerce and the future for SMEs in a global marketplace: Networking and public policies. *Small Business Economics*, 12(3), 261–275. <http://doi.org/10.1023/A:1008029924987>
- Ferneley, E., & Bell, F. (2006). Using bricolage to integrate business and information technology innovation in SMEs. *Technovation*, 26(2), 232–241. <https://doi.org/10.1016/j.technovation.2005.03.005>
- Fichman, R. G. (1992). Information technology diffusion: A review of empirical research. In *Proceedings of the Thirteenth International Conference on Information Systems (ICIS)*, Dallas (pp. 195–206).
- Fichman, R. G. (2004). Going beyond the dominant paradigm for information technology innovation research: Emerging concepts and methods. *Journal of the Association for Information Systems*, 5(8), 314–355. <https://doi.org/10.17705/1jais.00054>
- Fichman, R. G., Dos Santos, B. L., & Zheng, Z. E. (2014). Digital innovation as a fundamental and powerful concept in the information systems curriculum. *MIS Quarterly*, 38(2), 329–343. <https://doi.org/10.25300/MISQ/2014/38.2.01>
- Fink, D. (1998). Guidelines for the successful adoption of information technology in small and medium enterprises. *International Journal of Information Management*, 18(4), 243–253. [https://doi.org/10.1016/S0268-4012\(98\)00013-9](https://doi.org/10.1016/S0268-4012(98)00013-9)
- Francalanci, C., & Morabito, V. (2008). IS integration and business performance: The mediation effect of organizational absorptive capacity in SMEs. *Journal of Information Technology*, 23(4), 297–312. <https://doi.org/10.1057/jit.2008.18>
- Garbellano, S., & Da Veiga, M. D. R. (2019). Dynamic capabilities in Italian leading SMEs adopting industry 4.0. *Measuring Business Excellence*, 23(4), 472–483. <https://doi.org/10.1108/MBE-06-2019-0058>
- Gengatharen, D. E., & Standing, C. (2005). A framework to assess the factors affecting success or failure of the implementation of government-supported regional e-marketplaces for SMEs. *European Journal of Information Systems*, 14(4), 417–433. <https://doi.org/10.1057/palgrave.ejis.3000551>
- Gibson, T., & van der Vaart, H. J. (2008, September). *Defining SMEs: A less imperfect way of defining small and medium enterprises in developing countries*. Brooking Global Economy and Development Institution, Working papers Series. http://www.brookings.edu/~media/research/files/papers/2008/9/development%20gibson/09_development_gibson.pdf
- Grandon, E., & Pearson, J. M. (2004). E-commerce adoption: Perceptions of managers/owners of small and medium sized firms in Chile. *Communications of the Association for Information Systems*, 13(1), 81–102. <https://doi.org/10.1016/j.im.2003.12.010>
- Hajli, N., Sims, J., & Shanmugam, M. (2014). A practical model for e-commerce adoption in Iran. *Journal of Enterprise Information Management*, 27(6), 719–730. <https://doi.org/10.1108/JEIM-09-2013-0070>
- Hanclova, J., Rozehnal, P., Ministr, J., & Tvrdikova, M. (2015). The determinants of IT adoption in SMEs in the Czech-Polish border areas. *Information Technology for Development*, 21(3), 426–444. <https://doi.org/10.1080/02681102.2014.916249>
- Harrigan, P., Ramsey, E., & Ibbotson, P. (2009). Investigating the e-CRM activities of Irish SMEs. *Journal of Small Business and Enterprise Development*, 16(3), 443–465. <https://doi.org/10.1108/14626000910977161>
- Harrison, D. A., Mykytyn, P. P., Jr., & Riemenschneider, C. K. (1997). Executive decisions about adoption of information technology in small business: Theory and empirical tests. *Information Systems Research*, 8(2), 171–195. <https://doi.org/10.1287/isre.8.2.171>
- Holland, C. P., & Gutiérrez-Leefmans, M. (2018). A taxonomy of SME e-commerce platforms derived from a market-level analysis. *International Journal of Electronic Commerce*, 22(2), 161–201. <https://doi.org/10.1080/10864415.2017.1364114>

- Iacovou, C. L., Benbasat, I., & Dexter, A. S. (1995). Electronic data interchange and small organizations: Adoption and impact of technology. *MIS Quarterly*, 19(4), 465–485. <https://doi.org/10.2307/249629>
- IDC. (2016, February). *Thriving in the digital economy: How small and midsize enterprises are adapting to digital transformation*. An IDC InfoBrief, sponsored by SAP. <https://news.sap.com/wp-content/blogs.dir/1/files/IDC-Thriving-in-the-Digital-Economy.pdf>
- Ilavarasan, P. V. (2017). Bridging ICTD research and policy-making: Notes from a systematic review on MSMEs in the low- and middle-income countries. *Information Technology for Development*, 23(4), 723–733. <https://doi.org/10.1080/02681102.2017.1315355>
- Jeyaraj, A., Rottman, J. W., & Lacity, M. C. (2006). A review of the predictors, linkages, and biases in IT innovation adoption research. *Journal of Information Technology*, 21(1), 1–23. <https://doi.org/10.1057/palgrave.jit.2000056>
- Kabongo, J. D., & Okpara, J. O. (2014). ICT possession among Congolese SMEs: An exploratory study. *Journal of Small Business and Enterprise Development*, 21(2), 313–326. <https://doi.org/10.1108/JSBED-10-2013-0143>
- Karahanna, E., Straub, D. W., & Chervany, N. L. (1999). Information technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs. *MIS Quarterly*, 23(2), 183–213.
- Karunagaran, S., Mathew, S. K., & Lehner, F. (2019). Differential cloud adoption: A comparative case study of large enterprises and SMEs in Germany. *Information Systems Frontiers*, 21(4), 861–875. <https://doi.org/10.1007/s10796-017-9781-z>
- Kendall, J. D., Tung, L. L., Chua, K. H., Ng, C. H. D., & Tan, S. M. (2001). Receptivity of Singapore's SMEs to electronic commerce adoption. *The Journal of Strategic Information Systems*, 10(3), 223–242. [https://doi.org/10.1016/S0963-8687\(01\)00048-8](https://doi.org/10.1016/S0963-8687(01)00048-8)
- Kharub, M. (2019). Critical factors of effective implementation of IT-enabled ISO-9000 QMS. *International Journal of Quality & Reliability Management*, 36(9), 1600–1619. <https://doi.org/10.1108/IJQRM-09-2018-0253>
- Khazanchi, D. (2005). Information technology (IT) appropriateness: The contingency theory of “fit” and IT implementation in small and medium enterprises. *Journal of Computer Information Systems*, 45(3), 88–95. <https://doi.org/10.1080/08874417.2005.11645846>
- Kim, S. H., Jang, S. Y., & Yang, K. H. (2017). Analysis of the determinants of software-as-a-service adoption in small businesses: Risks, benefits, and organizational and environmental factors. *Journal of Small Business Management*, 55(2), 303–325. <https://doi.org/10.1111/jsbm.12304>
- Ko, W. W., & Liu, G. (2019). How Information technology assimilation promotes exploratory and exploitative innovation in the small- and medium-sized firm context: The role of contextual ambidexterity and knowledge base. *Journal of Product Innovation Management*, 36(4), 442–466. <https://doi.org/10.1111/jpim.12486>
- Kohli, R., & Melville, N. P. (2019). Digital innovation: A review and synthesis. *Information Systems Journal*, 29(1), 200–223. <https://doi.org/10.1111/isj.12193>
- Kuan, K. K., & Chau, P. Y. (2001). A perception-based model for EDI adoption in small businesses using a technology–organization–environment framework. *Information and Management*, 38(8), 507–521. [https://doi.org/10.1016/S0378-7206\(01\)00073-8](https://doi.org/10.1016/S0378-7206(01)00073-8)
- Kumar, D., Samalia, H. V., & Verma, P. (2017). Factors influencing cloud computing adoption by small and medium-sized enterprises (SMEs) in India. *Pacific Asia Journal of the Association for Information Systems*, 9(3), 25–48. <https://doi.org/10.17705/1pais.09302>
- Lal, K. (2002). E-business and manufacturing sector: A study of small and medium-sized enterprises in India. *Research Policy*, 31(7), 1199–1211. [https://doi.org/10.1016/S0048-7333\(01\)00191-3](https://doi.org/10.1016/S0048-7333(01)00191-3)
- Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, 33(1), 159–174. <https://doi.org/10.2307/2529310>
- Lee, J. S., & Kwon, Y. (2014). Exploring key factors of application software services and their relationships for organizational success in SMEs. *Journal of Small Business Management*, 52(4), 753–770. <https://doi.org/10.1111/jsbm.12053>
- Lee, M. R., & Lan, Y. C. (2011). Toward a unified knowledge management model for SMEs. *Expert Systems with Applications*, 38(1), 729–735. <https://doi.org/10.1016/j.eswa.2010.07.025>
- Levenburg, N., Magal, S. R., & Kosalge, P. (2006). An exploratory investigation of organizational factors and e-business motivations among SMFOEs in the US. *Electronic Markets*, 16(1), 70–84. <https://doi.org/10.1080/10196780500491402>
- Levy, M., & Powell, P. (2003). Exploring SME internet adoption: Towards a contingency model. *Electronic Markets*, 13(2), 173–181. <https://doi.org/10.1080/1019678032000067163>
- Lin, H. F. (2014). Contextual factors affecting knowledge management diffusion in SMEs. *Industrial Management and Data Systems*, 114(9), 1415–1437. <https://doi.org/10.1108/IMDS-08-2014-0232>
- Martin, L. M., & Matlay, H. (2001). ‘Blanket’ approaches to promoting ICT in small firms: Some lessons from the DTI ladder adoption model in the UK. *Internet Research*, 11(5), 399–410. <https://doi.org/10.1108/EUM0000000006118>
- Mbuyisa, B., & Leonard, A. (2017). The role of ICT use in SMEs towards poverty reduction: A systematic literature review. *Journal of International Development*, 29(2), 159–197. <https://doi.org/10.1002/jid.3258>
- Mehrtens, J., Cragg, P. B., & Mills, A. M. (2001). A model of Internet adoption by SMEs. *Information and Management*, 39(3), 165–176. [https://doi.org/10.1016/S0378-7206\(01\)00086-6](https://doi.org/10.1016/S0378-7206(01)00086-6)
- Melville, N., Kraemer, K., & Gurbaxani, V. (2004). Information technology and organizational performance: An integrative model of IT business value. *MIS Quarterly*, 28(2), 283–322. <https://doi.org/10.2307/25148636>

- Metaxiotis, K. (2009). Exploring the rationales for ERP and knowledge management integration in SMEs. *Journal of Enterprise Information Management*, 22(1/2), 51–62. <https://doi.org/10.1108/17410390910922822>
- Minh, N. D., Dat, L. Q., Son, N. H., Tuan, P. M., & Toan, N. D. (2017). Application of visual management in small medium enterprises in Vietnam. *International Journal of Entrepreneurship and Innovation Management*, 21(6), 509–529. <https://doi.org/10.1504/IJEIM.2017.086950>
- Molla, A., Heeks, R., & Balcells, I. (2006). Adding clicks to bricks: A case study of e-commerce adoption by a Catalan small retailer. *European Journal of Information Systems*, 15(4), 424–438. <https://doi.org/10.1057/palgrave.ejis.3000623>
- Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, 2(3), 192–222. <https://doi.org/10.1287/isre.2.3.192>
- Morgan-Thomas, A. (2016). Rethinking technology in the SME context: Affordances, practices and ICTs. *International Small Business Journal: Researching Entrepreneurship*, 34(8), 1122–1136. <https://doi.org/10.1177/0266242615613839>
- Naman, J. L., & Slevin, D. P. (1993). Entrepreneurship and the concept of fit: A model and empirical tests. *Strategic Management Journal*, 14(2), 137–153. <https://doi.org/10.1002/smj.4250140205>
- Newby, M., Nguyen, T. H., & Waring, T. S. (2014). Understanding customer relationship management technology adoption in small and medium-sized enterprises: An empirical study in the USA. *Journal of Enterprise Information Management*, 27(5), 541–560. <https://doi.org/10.1108/JEIM-11-2012-0078>
- Nguyen, T. H., & Waring, T. S. (2013). The adoption of customer relationship management (CRM) technology in SMEs: An empirical study. *Journal of Small Business and Enterprise Development*, 20(4), 824–848. <https://doi.org/10.1108/JSBED-01-2012-0013>
- Nooteboom, B., Coehoorn, C., & Der Zwaan, A. V. (1992). The purpose and effectiveness of technology transfer to small businesses by government-sponsored innovation centres. *Technology Analysis and Strategic Management*, 4(2), 149–166. <https://doi.org/10.1080/09537329208524089>
- North, K., Aramburu, N., & Lorenzo, O. J. (2019). Promoting digitally enabled growth in SMEs: A framework proposal. *Journal of Enterprise Information Management*, 33(1), 238–262. <https://doi.org/10.1108/JEIM-04-2019-0103>
- Ntwoku, H., Negash, S., & Meso, P. (2017). ICT adoption in Cameroon SME: Application of Bass diffusion model. *Information Technology for Development*, 23(2), 296–317. <https://doi.org/10.1080/02681102.2017.1289884>
- OECD. (2005). *Small and medium-sized enterprises (SMEs)*. Retrieved January 2018 from <https://stats.oecd.org/glossary/detail.asp?ID=3123>
- OECD. (2017, January 12). *Key issues for digital transformation in the G20*. Report prepared for a Joint G20 German Presidency/OECD Conference, Berlin. <https://www.oecd.org/g20/key-issues-for-digital-transformation-in-the-g20.pdf>
- Oh, K. Y., Cruickshank, D., & Anderson, A. R. (2009). The adoption of e-trade innovations by Korean small and medium sized firms. *Technovation*, 29(2), 110–121. <https://doi.org/10.1016/j.technovation.2008.08.001>
- Osterwalder, A. (2004). Understanding ICT-based business models in developing countries. *International Journal of Information Technology and Management*, 3(2-4), 333–348. <https://doi.org/10.1504/IJITM.2004.005042>
- Oyelaran-Oyeyinka, B., & Lal, K. (2006). Learning new technologies by small and medium enterprises in developing countries. *Technovation*, 26(2), 220–231. <https://doi.org/10.1016/j.technovation.2004.07.015>
- Palvia, P. C., & Palvia, S. C. (1999). An examination of the IT satisfaction of small-business users. *Information and Management*, 35(3), 127–137. [https://doi.org/10.1016/S0378-7206\(98\)00086-X](https://doi.org/10.1016/S0378-7206(98)00086-X)
- Panizzolo, R. (1998). Managing innovation in SMEs: A multiple case analysis of the adoption and implementation of product and process design technologies. *Small Business Economics*, 11(1), 25–42. <https://doi.org/10.1023/A:1007941228765>
- Peltier, J. W., Zhao, Y., & Schibrowsky, J. A. (2012). Technology adoption by small businesses: An exploratory study of the interrelationships of owner and environmental factors. *International Small Business Journal: Researching Entrepreneurship*, 30(4), 406–431. <https://doi.org/10.1177/0266242610365512>
- Peón, D., & Martínez-Filgueira, X. (2020). Determinants of investing in innovative activities by agri-food and KIBS firms in rural areas: An exploratory analysis. *Journal of Small Business Management*, 58(6), 1155–1186. <https://doi.org/10.1111/jsbm.12513>
- Pérez-González, D., Trigueros-Preciado, S., & Popa, S. (2017). Social media technologies' use for the competitive information and knowledge sharing, and its effects on industrial SMEs' innovation. *Information Systems Management*, 34(3), 291–301. <https://doi.org/10.1080/10580530.2017.1330007>
- Pergelova, A., Manolova, T., Simeonova-Ganeva, R., & Yordanova, D. (2019). Democratizing entrepreneurship? Digital technologies and the internationalization of female-led SMEs. *Journal of Small Business Management*, 57(1), 14–39. <https://doi.org/10.1111/jsbm.12494>
- Premkumar, G., & Roberts, M. (1999). Adoption of new information technologies in rural small businesses. *Omega*, 27(4), 467–484. [https://doi.org/10.1016/S0305-0483\(98\)00071-1](https://doi.org/10.1016/S0305-0483(98)00071-1)
- Puklavec, B., Oliveira, T., & Popovič, A. (2018). Understanding the determinants of business intelligence system adoption stages. *Industrial Management & Data Systems*, 118(1), 236–261. <https://doi.org/10.1108/IMDS-05-2017-0170>
- Qureshi, S. (2015). Are we making a better world with information and communication technology for development (ICT4D) research? Findings from the field and theory building. *Information Technology for Development*, 21(4), 511–522. <https://doi.org/10.1080/02681102.2015.1080428>

- Qureshi, S., Kamal, M., & Wolcott, P. (2009). Information technology interventions for growth and competitiveness in micro-enterprises. *International Journal of Enterprise Information Systems*, 5(2), 71–95. <https://doi.org/10.4018/jeis.2009040105>
- Ramdani, B., Chevers, D., & Williams, D. A. (2013). SMEs' adoption of enterprise applications: A technology-organisation-environment model. *Journal of Small Business and Enterprise Development*, 20(4), 735–753. <https://doi.org/10.1108/JSBED-12-2011-0035>
- Ramdani, B., Kawalek, P., & Lorenzo, O. (2009). Predicting SMEs' adoption of enterprise systems. *Journal of Enterprise Information Management*, 22(1/2), 10–24. <https://doi.org/10.1108/17410390910922796>
- Ramsey, E., Ibbotson, P., & McCole, P. (2008). Factors that impact technology innovation adoption among Irish professional service sector SMEs. *International Journal of Innovation Management*, 12(4), 629–654. <https://doi.org/10.1142/S1363919608002114>
- Rangaswamy, N., & Nair, S. (2012). The PC in an Indian urban slum: Enterprise and entrepreneurship in ICT4D 2.0. *Information Technology for Development*, 18(2), 163–180. <https://doi.org/10.1080/02681102.2011.643211>
- Raymond, L. (2001). Determinants of web site implementation in small businesses. *Internet Research*, 11(5), 411–424. <https://doi.org/10.1108/10662240110410363>
- Riemenschneider, C. K., Harrison, D. A., & Mykytyn, P. P., Jr. (2003). Understanding IT adoption decisions in small business: Integrating current theories. *Information and Management*, 40(4), 269–285. [https://doi.org/10.1016/S0378-7206\(02\)00010-1](https://doi.org/10.1016/S0378-7206(02)00010-1)
- Riemenschneider, C. K., & McKinney, V. R. (2002). Assessing belief differences in small business adopters and non-adopters of web-based e-commerce. *Journal of Computer Information Systems*, 42(2), 101–107. <https://doi.org/10.1080/08874417.2002.11647494>
- Rogers, E. (1983). *Diffusion of innovations*. Free Press.
- Ruivo, P., Oliveira, T., Johansson, B., & Neto, M. (2013). Differential effects on ERP post-adoption stages across Scandinavian and Iberian SMEs. *Journal of Global Information Management*, 21(3), 1–20. <https://doi.org/10.4018/jgim.2013070101>
- Scuotto, V., Del Giudice, M., & Obi Omeihe, K. (2017). SMEs and mass collaborative knowledge management: Toward understanding the role of social media networks. *Information Systems Management*, 34(3), 280–290. <https://doi.org/10.1080/10580530.2017.1330006>
- Scupola, A. (2009). SMEs' e-commerce adoption: Perspectives from Denmark and Australia. *Journal of Enterprise Information Management*, 22(1/2), 152–166. <https://doi.org/10.1108/17410390910932803>
- Scupola, A. (2003). The adoption of Internet commerce by SMEs in the south of Italy: An environmental, technological and organizational perspective. *Journal of Global Information Technology Management*, 6(1), 52–71. <https://doi.org/10.1080/1097198X.2003.10856343>
- Senarathna, I., Warren, M., Yeoh, W., & Salzman, S. (2014). The influence of organisation culture on E-commerce adoption. *Industrial Management and Data Systems*, 114(7), 1007–1021. <https://doi.org/10.1108/IMDS-03-2014-0076>
- Shah Alam, S. (2009). Adoption of internet in Malaysian SMEs. *Journal of Small Business and Enterprise Development*, 16(2), 240–255. <https://doi.org/10.1108/14626000910956038>
- Sharma, S., Daniel, E. M., & Gray, C. (2012). Absorptive capacity and ERP implementation in Indian medium-sized firms. *Journal of Global Information Management*, 20(4), 54–79. <https://doi.org/10.4018/jgim.2012100103>
- Shin, I. (2006). Adoption of enterprise application software and firm performance. *Small Business Economics*, 26(3), 241–256. <https://doi.org/10.1007/s11187-005-0215-9>
- Sivathanu, B. (2019). Adoption of industrial IoT (IIoT) in auto-component manufacturing SMEs in India. *Information Resources Management Journal*, 32(2), 52–75. <https://doi.org/10.4018/IRMJ.2019040103>
- Soto-Acosta, P., Popa, S., & Martinez-Conesa, I. (2018). Information technology, knowledge management and environmental dynamism as drivers of innovation ambidexterity: A study in SMEs. *Journal of Knowledge Management*, 22(4), 824–849. <https://doi.org/10.1108/JKM-10-2017-0448>
- Stair, R. M., Jr. (1979). Acquiring computer programs and software for the small business. *Journal of Small Business Management*, 1730(41), 37–42.
- Stroeken, J. H. (2001). The adoption of IT by SMEs: The Dutch case. *Journal of Enterprising Culture*, 9(1), 129–152. <https://doi.org/10.1142/S0218495801000080>
- Sullivan, P., & Kang, J. (1999). Quick response adoption in the apparel manufacturing industry: Competitive advantage of innovation. *Journal of Small Business Management*, 37(1), 1–13.
- Sultan, N. A. (2011). Reaching for the “cloud”: How SMEs can manage. *International Journal of Information Management*, 31(3), 272–278. <https://doi.org/10.1016/j.ijinfomgt.2010.08.001>
- Tajvidi, R., & Karami, A. (2017). The effect of social media on firm performance. *Computers in Human Behavior*, 115, 1–10. <https://doi.org/10.1016/j.chb.2017.09.026>
- Tan, S. K., Chong, C. S., Lin, B., & Eze, C. U. (2010). Internet-based ICT adoption among SMEs: Demographic versus benefits, barriers, and adoption intention. *Journal of Enterprise Information Management*, 23(1), 27–55. <https://doi.org/10.1108/17410391011008897>

- Thakkar, J., Kanda, A., & Deshmukh, S. G. (2008). A conceptual role interaction model for supply chain management in SMEs. *Journal of Small Business and Enterprise Development*, 15(1), 74–95. <https://doi.org/10.1108/14626000810850856>
- Thong, J. Y. (1999). An integrated model of information systems adoption in small businesses. *Journal of Management Information Systems*, 15(4), 187–214. <https://doi.org/10.1080/07421222.1999.11518227>
- Thong, J. Y., & Yap, C. S. (1995). CEO characteristics, organizational characteristics and information technology adoption in small businesses. *Omega*, 23(4), 429–442. [https://doi.org/10.1016/0305-0483\(95\)00017-1](https://doi.org/10.1016/0305-0483(95)00017-1)
- Tornatzky, L. G., Fleischer, M., & Chakrabarti, A. K. (1990). *The processes of technological innovation. Issues in organization and management series*. Lexington Books.
- Uwizeyemungu, S., Raymond, L., Poba-Nzaou, P., & St-Pierre, J. (2018). The complementarity of IT and HRM capabilities for competitive performance: A configurational analysis of manufacturing and industrial service SMEs. *Enterprise Information Systems*, 12(10), 1336–1358. <https://doi.org/10.1080/17517575.2018.1448118>
- Van Beijsterveld, J. A., & Van Groenendaal, W. J. (2016). Solving misfits in ERP implementations by SMEs. *Information Systems Journal*, 26(4), 369–393. <https://doi.org/10.1111/isj.12090>
- Verbano, C., & Crema, M. (2016). Linking technology innovation strategy, intellectual capital and technology innovation performance in manufacturing SMEs. *Technology Analysis and Strategic Management*, 28(5), 524–540. <https://doi.org/10.1080/09537325.2015.1117066>
- vom Brocke, J., Simons, A., Riemer, K., Niehaves, B., Plattfaut, R., & Cleven, A. (2015). Standing on the shoulders of giants: Challenges and recommendations of literature search in information systems research. *Communications of the Association for Information Systems*, 37(1), 205–244. <https://doi.org/10.17705/1CAIS.03709>
- Wang, C. L., & Chugh, H. (2013). Entrepreneurial learning: Past research and future challenges. *International Journal of Management Reviews*, 16(1), 24–61. <https://doi.org/10.1111/ijmr.12007>
- Wielicki, T., & Arendt, L. (2010). A knowledge-driven shift in perception of ICT implementation barriers: Comparative study of US and European SMEs. *Journal of Information Science*, 36(2), 162–174. <https://doi.org/10.1177/0165551509354417>
- Woolgar, S., Gomes, P., Vaux, J., Ezingeard, J. N., & Grieve, R. (1998). Abilities and competencies required, particularly by small firms, to identify and acquire new technology. *Technovation*, 18, 575–584. <https://doi.org/10.1049/ic:19971216>
- World Bank. (2018). *World Bank country and lending groups*. <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>
- World Bank. (2019). *The changing nature of work, world development report*. <http://www.worldbank.org/en/publication/wdr2019>
- Wymer, S., & Regan, E. A. (2011). Influential factors in the adoption and use of e-business and e-commerce information technology (EEIT) by small and medium businesses. *Journal of Electronic Commerce in Organizations*, 9(1), 56–82. <https://doi.org/10.4018/jeco.2011010104>
- Yang, C., & Su, Y. F. (2009). The relationship between benefits of ERP systems implementation and its impacts on firm performance of SCM. *Journal of Enterprise Information Management*, 22(6), 722–752. <https://doi.org/10.1108/17410390910999602>
- Yap, C. S., Soh, C. P. P., & Raman, K. S. (1992). Information systems success factors in small business. *Omega*, 20(5-6), 597–609. [https://doi.org/10.1016/0305-0483\(92\)90005-R](https://doi.org/10.1016/0305-0483(92)90005-R)
- Yee-Loong Chong, A., Ooi, K. B., Lin, B., & Yi Tang, S. (2009). Influence of interorganizational relationships on SMEs' e-business adoption. *Internet Research*, 19(3), 313–331. <https://doi.org/10.1108/10662240910965379>
- Yunis, M., El-Kassar, A. N., & Tarhini, A. (2017). Impact of ICT-based innovations on organizational performance: The role of corporate entrepreneurship. *Journal of Enterprise Information Management*, 30(1), 122–141. <https://doi.org/10.1108/JEIM-01-2016-0040>